Exhibit A

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Sasaki et al.

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(54) **REWRITABLE OPTICAL RECORDING MEDIUM AND MANUFACTURING METHOD AND APPARATUS THEREFOR**

(75) Inventors: **Yoshio Sasaki**, Tokorozawa (JP); **Toshihiko Maruyama**, Tokorozawa (JP); **Eiji Muramatsu**, Tokorozawa (JP); **Masahiro Kato**, Tokorozawa (JP); **Seiro Oshima**, Nakakoma-gun (JP); **Takao Tagiri**, Nakakoma-gun (JP)

(73) Assignee: **Pioneer Corporation**, Tokyo (JP)

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(30) **Foreign Application Priority Data**

Jul. 6, 2000 (JP) 2000-205328

(51) **Int. Cl.**[7] **G11B 7/24**
(52) **U.S. Cl.** **369/275.4**; 369/277
(58) **Field of Search** 369/275.4, 277

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,769,802 A		9/1988	Tatsduguchi	
4,985,881 A	*	1/1991	Saito et al.	369/275.4 X
5,402,411 A	*	3/1995	Maeda et al.	369/275.1
5,452,284 A	*	9/1995	Miyagawa et al.	369/275.4 X
5,553,051 A		9/1996	Sugiyama et al.	

FOREIGN PATENT DOCUMENTS

EP	0626679 A2 *	11/1994	G11B/7/007
JP	07-192272	7/1995	
JP	08-241539	9/1996	
JP	08-306080	11/1996	
JP	09-81968	3/1997	
JP	11-73686	3/1999	
JP	11-120622	4/1999	
JP	11-328738	11/1999	
JP	2000-76718	3/2000	
JP	2000-187887	7/2000	
JP	2001-076349	3/2001	

* cited by examiner

Primary Examiner—Aristotelis M. Psitos
(74) *Attorney, Agent, or Firm*—Morgan, Lewis & Bockius LLP

(57) **ABSTRACT**

A rewritable optical recording medium includes a segmented groove area in which the groove track is segmented along a rotating direction of the recording medium by groove non-forming portions to form a plurality of groove portions; and a continuous groove area in which a continuous groove is formed, the continuous groove having a groove width smaller than a groove width in the segmented groove area.

5 Claims, 9 Drawing Sheets

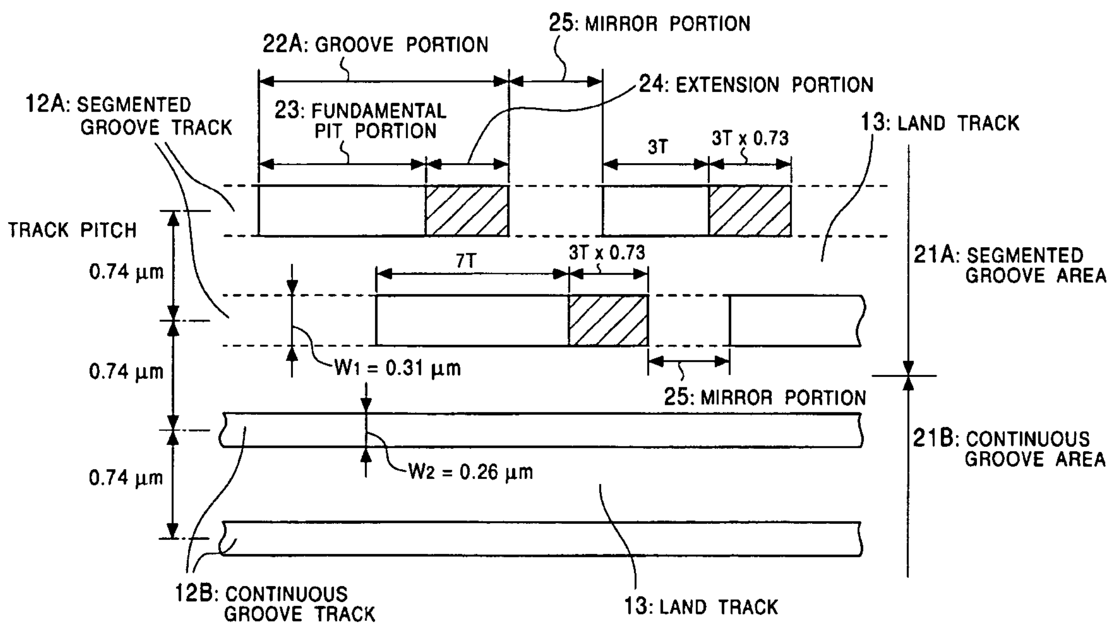


FIG. 1

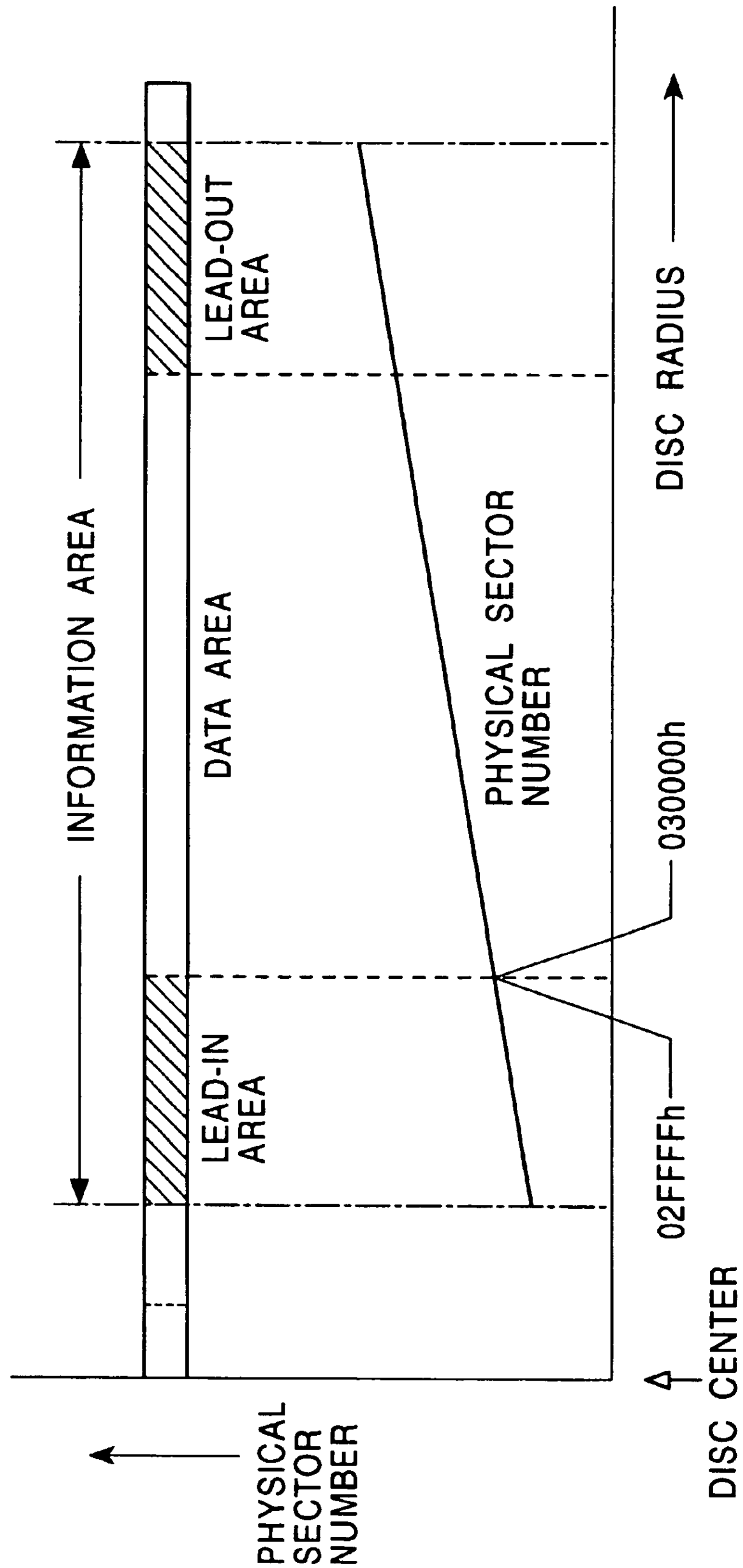

INFORMATION AREA
LEAD-OUT AREA
DATA AREA
LEAD-IN AREA
PHYSICAL SECTOR NUMBER
030000h
02FFFFh
DISC RADIUS
DISC CENTER
PHYSICAL SECTOR NUMBER

FIG. 2

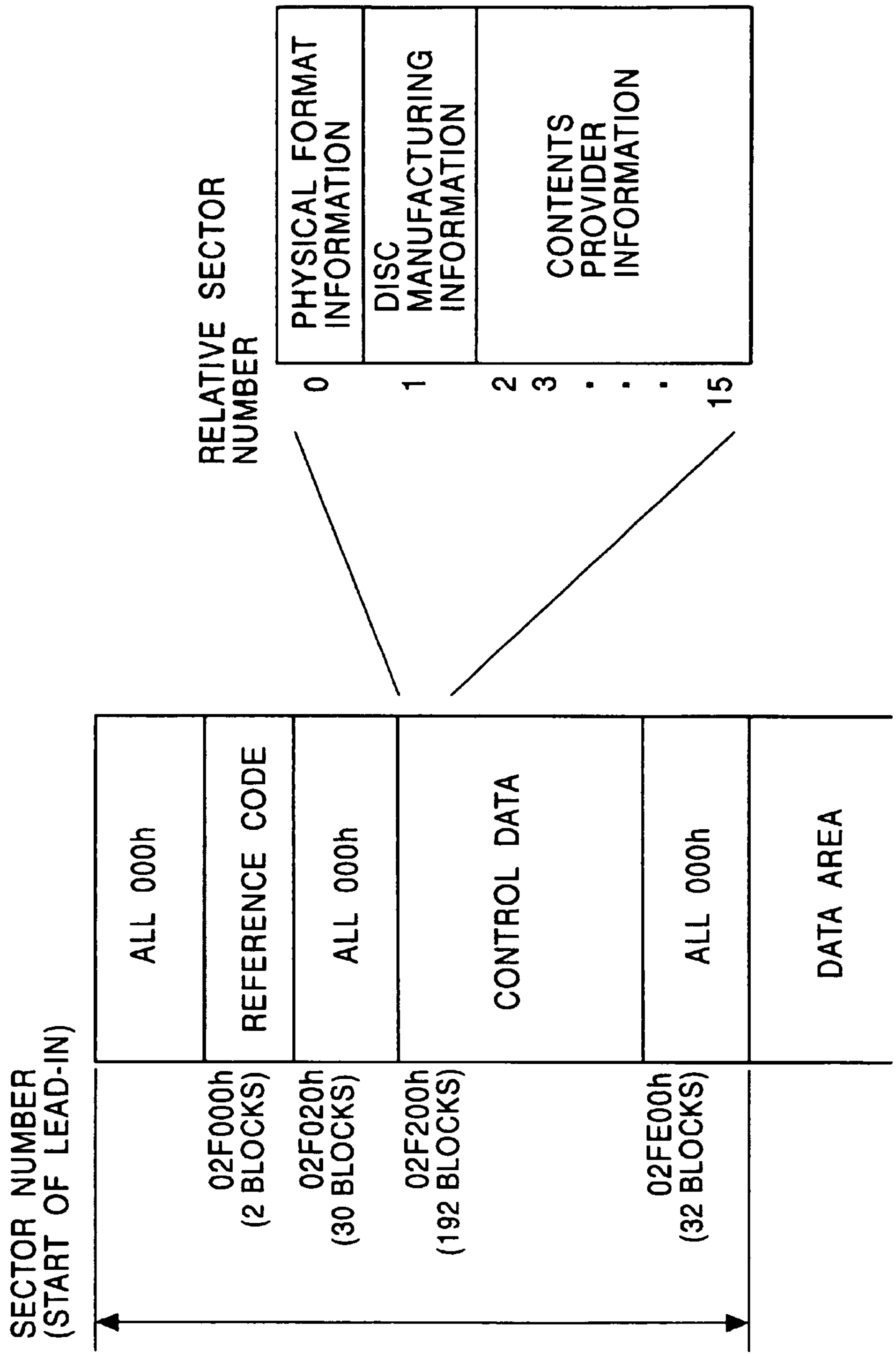

RELATIVE SECTOR NUMBER
0
1
2
3
15
PHYSICAL FORMAT INFORMATION
DISC MANUFACTURING INFORMATION
CONTENTS PROVIDER INFORMATION
SECTOR NUMBER (START OF LEAD-IN)
ALL 000h
02F000h (2 BLOCKS)
REFERENCE CODE
02F020h (30 BLOCKS)
ALL 000h
02F200h (192 BLOCKS)
CONTROL DATA
02FE00h (32 BLOCKS)
ALL 000h
DATA AREA

FIG. 3

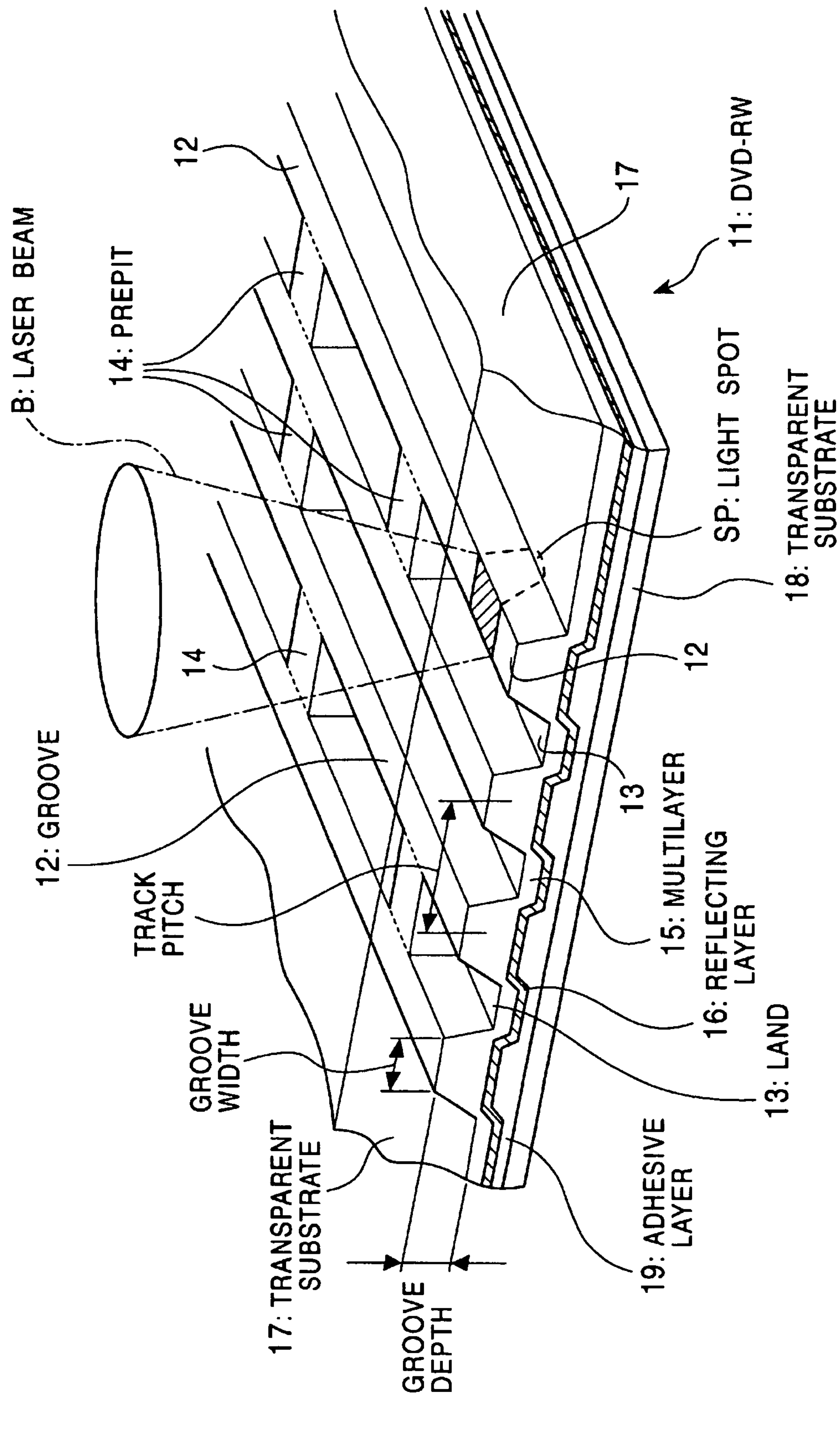

B: LASER BEAM
14: PREPIT
12
17
11: DVD-RW
SP: LIGHT SPOT
18: TRANSPARENT SUBSTRATE
14
12
12: GROOVE
13
15: MULTILAYER
TRACK PITCH
16: REFLECTING LAYER
GROOVE WIDTH
13: LAND
17: TRANSPARENT SUBSTRATE
19: ADHESIVE LAYER
GROOVE DEPTH

FIG. 4

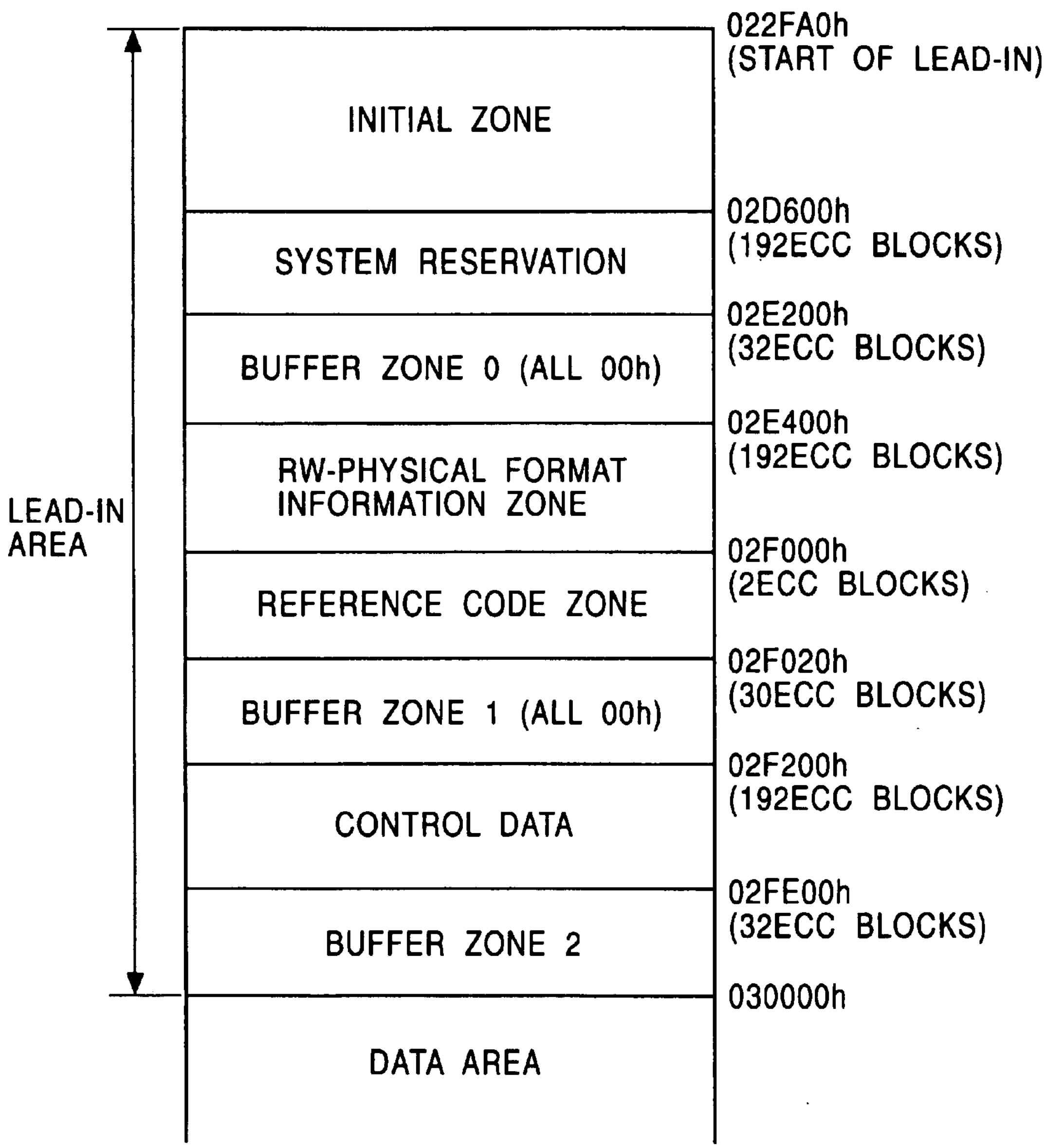

022FA0h
(START OF LEAD-IN)
INITIAL ZONE
02D600h
(192ECC BLOCKS)
SYSTEM RESERVATION
02E200h
(32ECC BLOCKS)
BUFFER ZONE 0 (ALL 00h)
02E400h
(192ECC BLOCKS)
RW-PHYSICAL FORMAT INFORMATION ZONE
LEAD-IN AREA
02F000h
(2ECC BLOCKS)
REFERENCE CODE ZONE
02F020h
(30ECC BLOCKS)
BUFFER ZONE 1 (ALL 00h)
02F200h
(192ECC BLOCKS)
CONTROL DATA
02FE00h
(32ECC BLOCKS)
BUFFER ZONE 2
030000h
DATA AREA

FIG. 5

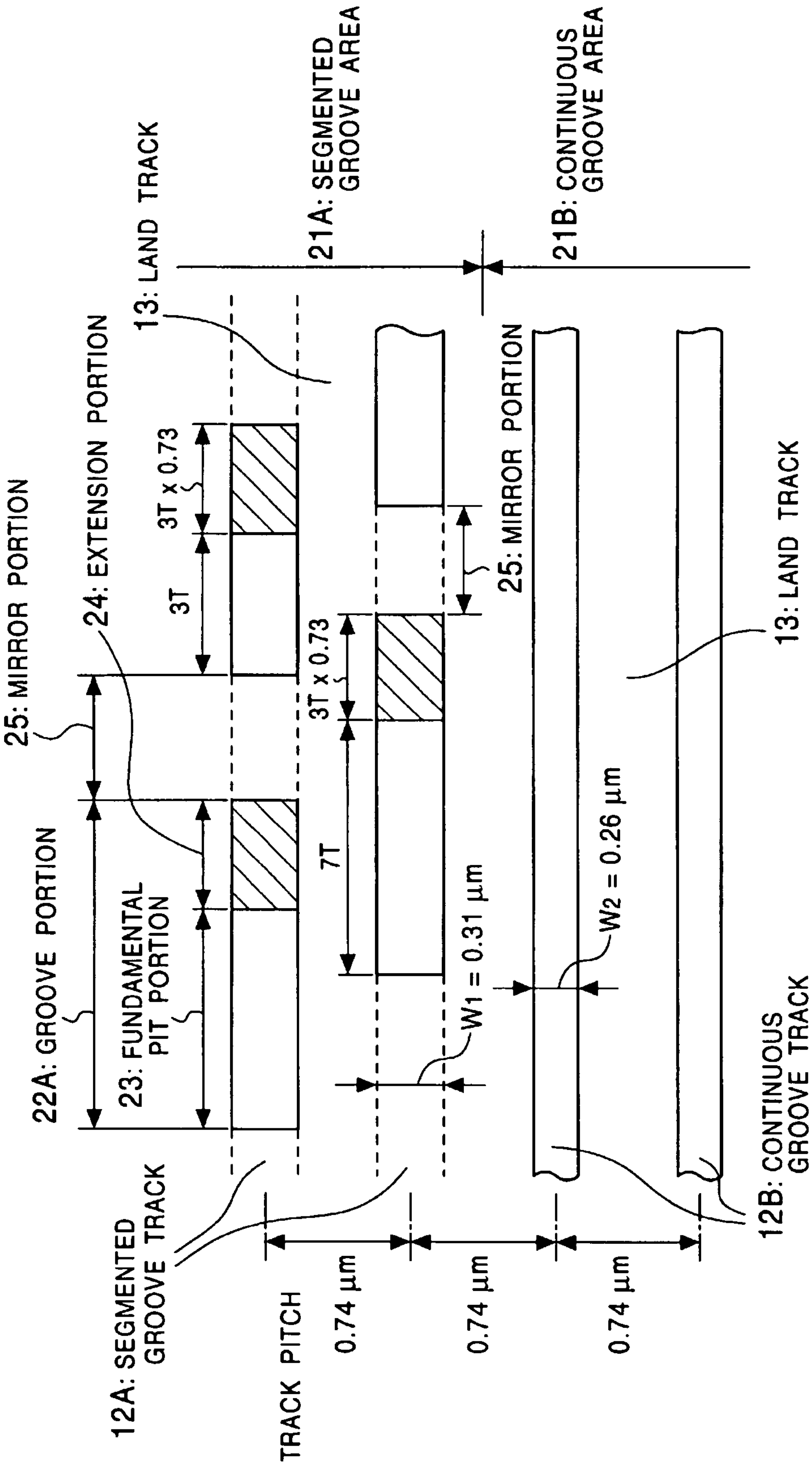

13: LAND TRACK
21A: SEGMENTED GROOVE AREA
21B: CONTINUOUS GROOVE AREA
25: MIRROR PORTION
24: EXTENSION PORTION
3T x 0.73
3T
25: MIRROR PORTION
3T x 0.73
7T
22A: GROOVE PORTION
23: FUNDAMENTAL PIT PORTION
13: LAND TRACK
W2 = 0.26 μm
W1 = 0.31 μm
12A: SEGMENTED GROOVE TRACK
12B: CONTINUOUS GROOVE TRACK
TRACK PITCH
0.74 μm
0.74 μm
0.74 μm

FIG. 6

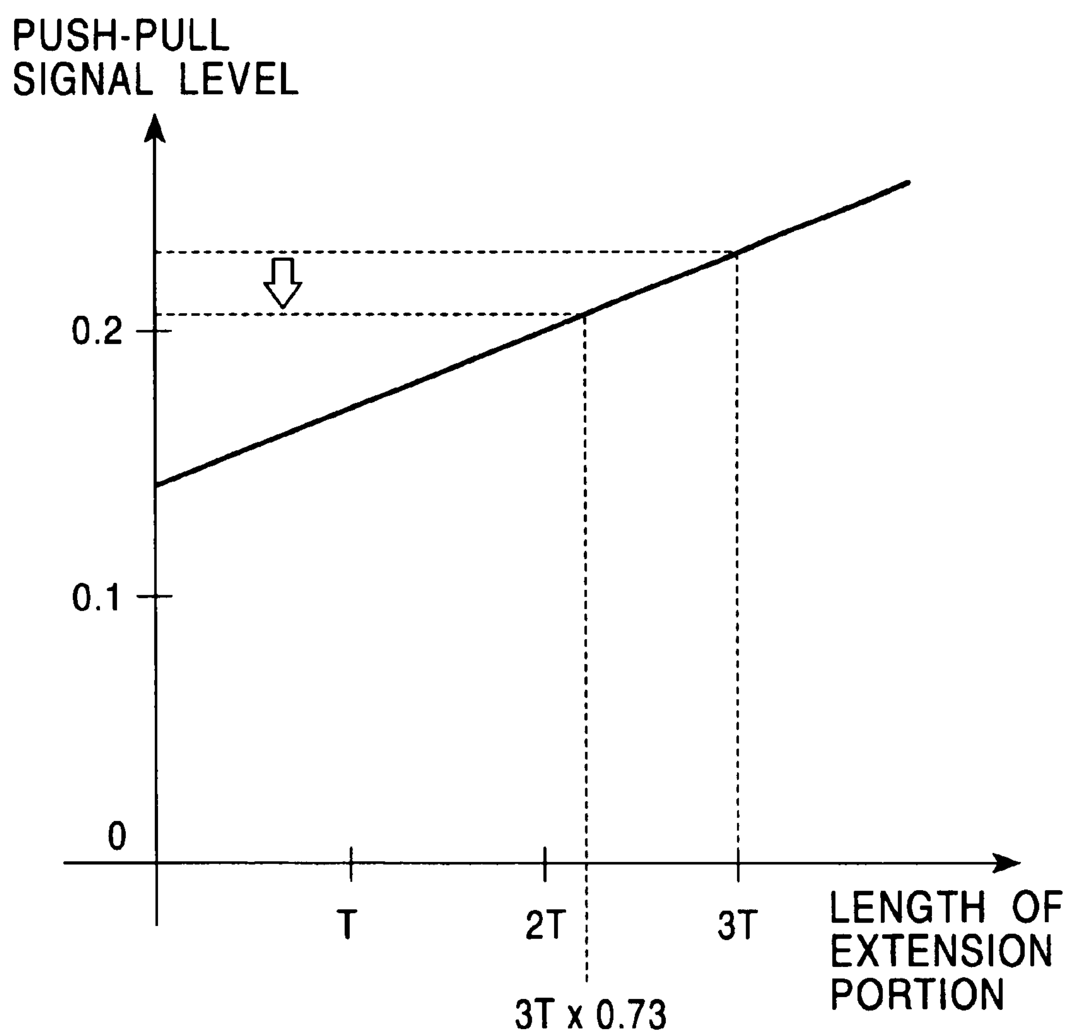

PUSH-PULL
SIGNAL LEVEL
0.2
0.1
0
T
2T
3T
3T x 0.73
LENGTH OF
EXTENSION
PORTION

FIG. 7

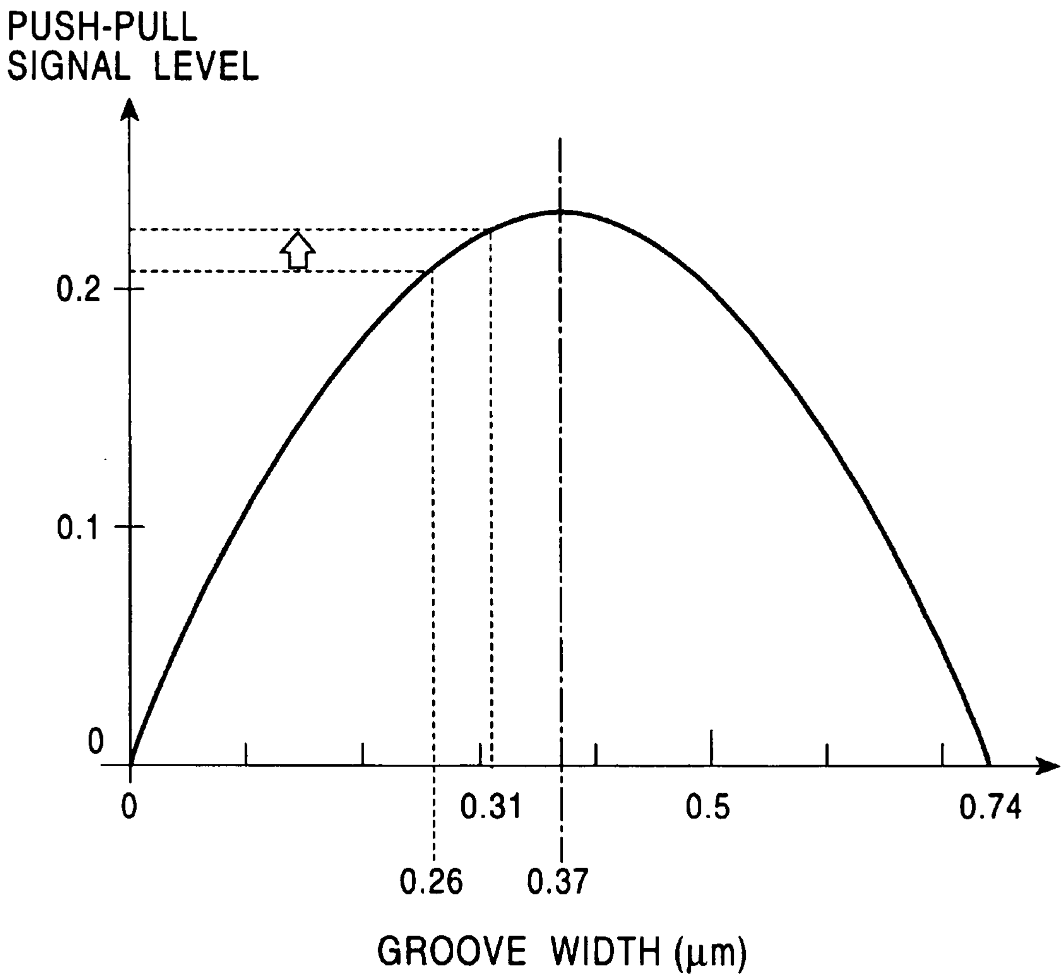

PUSH-PULL
SIGNAL LEVEL
0.2
0.1
0
0
0.31
0.5
0.74
0.26
0.37
GROOVE WIDTH (μm)

FIG. 8

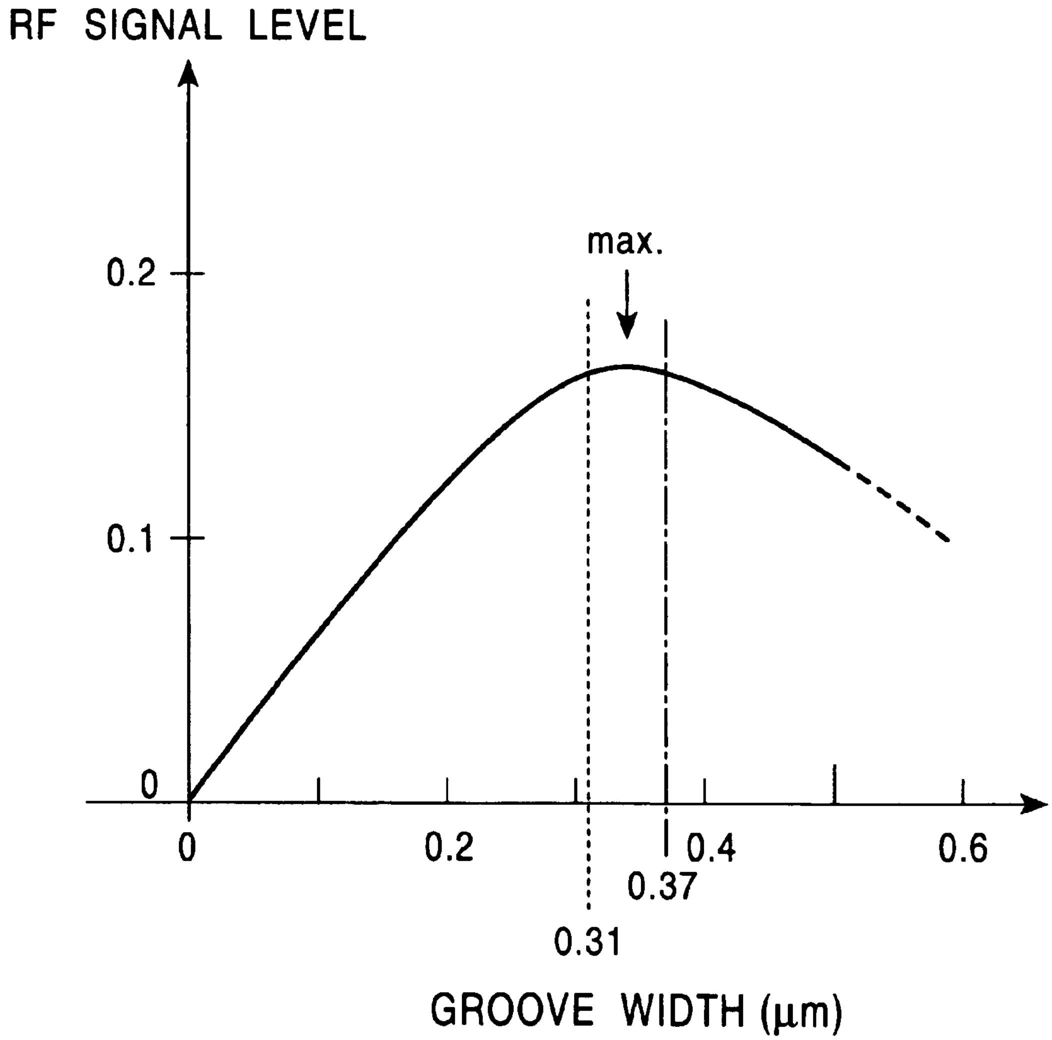
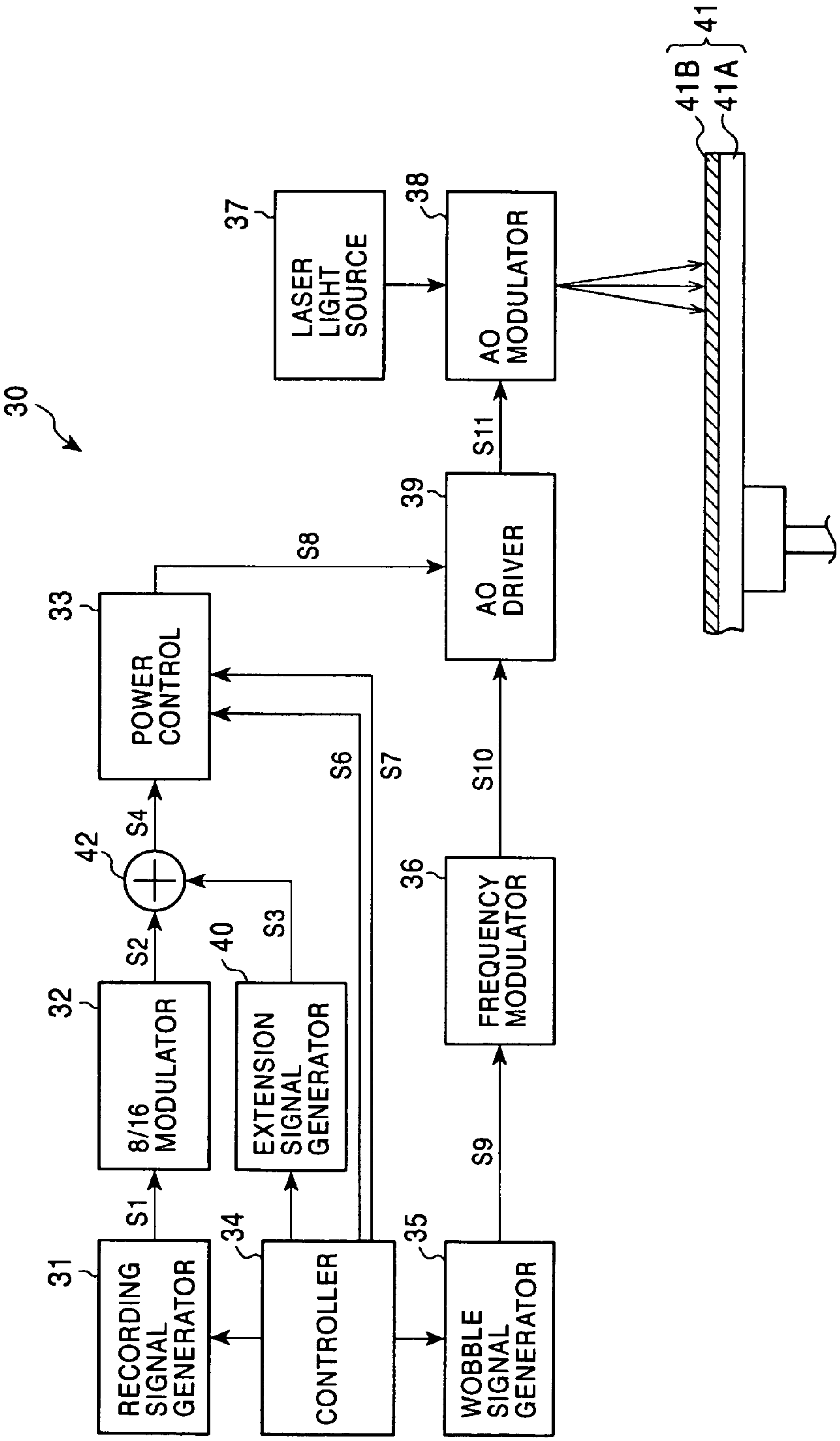


FIG. 9


30
RECORDING SIGNAL GENERATOR
31
CONTROLLER
34
WOBBLE SIGNAL GENERATOR
35
8/16 MODULATOR
32
EXTENSION SIGNAL GENERATOR
40
FREQUENCY MODULATOR
36
S1
S2
S3
S4
S6
S7
S8
S9
S10
S11
42
POWER CONTROL
33
AO DRIVER
39
LASER LIGHT SOURCE
37
AO MODULATOR
38
41B
41A
41

REWRITABLE OPTICAL RECORDING MEDIUM AND MANUFACTURING METHOD AND APPARATUS THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a rewritable optical recording medium and a manufacturing method and apparatus therefor. More particularly, the present invention relates to a rewritable optical recording medium and manufacturing method and apparatus therefor in which data can be recorded by the user and illegal recording and reproduction of data are disabled.

2. Description of the Related Art

Optical recording media such as a write-once DVD-R (Digital Versatile Disc—Recordable) and a rewritable DVD-RW (DVD—Re-recordable) are being put into practical use or under further development. The discs have a recording capacity of a few gigabytes (GB) and data can be recorded by the user thereon. High-volume data copying can be made with almost no loss of data quality due to the remarkable improvement in performance of the large-capacity digital optical recording media as mentioned above and a recording and reproducing apparatus.

FIG. 1 is a diagram showing a layout of a physical sector in the radial direction on the recording surface of a recorded DVD-ROM (DVD—Read Only Memory). Information data is recorded in an information area. A lead-in area, a data area, and a lead-out area are sequentially provided along the radial direction from a start point of the information area (i.e., start point of the physical sector).

The lead-in area includes data for reproduction of the disc such as a reference code, control data for configuring a reproduction control data signal, and the like as shown in FIG. 2. A control data area is constructed by 192 ECC (Error Correction Code) blocks. In FIG. 2, constructions of the ECC blocks in the control data area are shown by using relative sector numbers 0 to 15. Each of the contents in those ECC blocks are the same control data. In other words, 192 control data of the same contents are sequentially and repetitively recorded. The ECC block consists of 16 sectors. There is recorded in each ECC block important information regarding copy protection including physical format information, disc manufacturing information, and contents provider information. The control data regarding reproduction is recorded into the control data area in the lead-in area when the information data is recorded. When the disc is reproduced, the reproducing apparatus reads the data and executes reproduction of the recorded information data such as video data and the like on the basis of the read information.

If the data in the DVD-ROM disc is RF-copied (i.e., a read signal (RF signal) is recorded as it is by a recording circuit without being subjected to signal processing) into the rewritable DVD-RW disc and the control data is illegally falsified, an illegal DVD-RW disc which cannot be distinguished from the DVD-ROM disc (i.e., an exact or a dead copy of the DVD-ROM disc) can be produced. Since a high quality and a large capacity copy can be easily made by using the DVD-RW disc as mentioned above, development of a copy protection technique is an important subject to prevent a false or illegal copy of the recorded data such as video/audio data, a computer program, or the like.

OBJECTS AND SUMMARY OF THE INVENTION

The present invention is made in consideration of the foregoing problems and it is an object of the present invention to provide a rewritable optical recording medium which prevents illegal recording and reproduction of information data and manufacturing method and apparatus therefor.

To achieve the object, according to one aspect of the present invention, there is provided a rewritable optical recording medium on which a land track and a groove track for recording a data signal are formed, which comprises a segmented groove area in which the groove track is segmented along a rotating direction of the optical recording medium by groove non-forming portions to form a plurality of groove portions; and a continuous groove area in which a continuous groove is formed, the continuous groove having a groove width smaller than a groove width in the segmented groove area.

According to another aspect of the present invention, there is provided A method of manufacturing a master disc for a rewritable optical recording medium having a land track and a groove track for recording a data signal by irradiating a laser beam on the master disc, which comprises the steps of forming a segmented groove track having a plurality of groove portions in a first area of the optical recording medium along a rotating direction of the optical recording medium; and forming, in a second area of the optical recording medium, a continuous groove track having a groove width smaller than a groove width of the first area.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram showing a layout of a physical sector in the radial direction of a recording surface of a recorded DVD-ROM;

FIG. 2 is a diagram showing a configuration of a lead-in area and a detailed configuration of a control data area;

FIG. 3 is a perspective view schematically showing a structure of a recording surface of a DVD-RW disc;

FIG. 4 is a diagram showing a detailed configuration of a lead-in area of a DVD-RW disc;

FIG. 5 is a plan view schematically showing a boundary area of a buffer zone 1 and a control data zone of the DVD-RW disc according to the first embodiment of the present invention;

FIG. 6 is a graph showing a push-pull signal level against a length of an extension portion;

FIG. 7 is a graph showing the push-pull signal level against a groove width;

FIG. 8 is a graph showing an RF signal level which is caused due to intermittence of groove tracks against the groove width; and

FIG. 9 is a block diagram showing a configuration of a manufacturing apparatus of a master disc of an optical disc.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will now be described in detail hereinbelow with reference to the drawings.

FIG. 3 is a perspective view schematically showing a structure of a recording surface of a conventional DVD-RW disc.

In FIG. 3, an optical disc (DVD-RW) **11** is a phase change type optical disc in which information data is rewritable and which has a multilayer **15** constructed by a recording layer made of a phase change material (for example, GeSbTe) serving as a data recording layer and a protecting layer made of a glass material ($ZnS—SiO_2$) which sandwiches the

recording layer. Groove tracks **12** and land tracks **13** are formed thereon. The groove tracks **12** serve as information recording tracks and land tracks **13** serve as guide tracks for guiding a laser beam (B) on the groove track **12** for reproduction or recording. The optical disc also has a reflecting layer **16** for reflecting the laser beam (B) when recorded data is reproduced and an adhesive layer **19** for adhering those layers on a transparent substrate (polycarbonate) **18**. Further, a transparent substrate (polycarbonate) **17** for protecting the layers is provided on the beam incidence surface of the disc. Prepits **14** corresponding to pre-information (i.e., previously recorded information) are formed on the land track **13**. The prepits **14** carry the pre-information which is used by an information recording/reproducing apparatus upon recording or reproduction. The pre-information includes an address information for recognizing a position on the groove track **12** and sync information. The prepits **14** are formed prior to shipment of the optical disc **11**.

Further, on the optical disc **11**, the groove track **12** has been wobbled at a frequency corresponding to a disc rotational speed. The groove tracks **12** are wobbled prior to shipment of the optical disc **11**. On the conventional optical disc **11**, the groove tracks **12** have a predetermined groove width and a predetermined groove depth and are formed at a predetermined track pitch.

When recording information data (i.e., information data such as image information to be recorded other than the pre-information) is recorded on the optical disc **11**, the wobbling frequency of the groove tracks **12** is extracted in the information recording apparatus for controlling the optical disc **11** to rotate at a predetermined rotational speed. At the same time, the prepits **14** are preliminarily detected to obtain the pre-information. An optimum output of the laser beam (B) as a recording light is determined on the basis of the pre-information. Address information indicating a position on the optical disc **11** where the recording information data should be recorded are obtained on the basis of the pre-information. The recording information data is recorded at the corresponding recording position on the basis of the address information.

When the recording information data is recorded, the laser beam (B) is irradiated so that the beam center coincides with the center of the groove track **12** and recording information pits corresponding to the recording information data are formed on the groove track **12**. In this instance, as shown in FIG. **3**, a size of the light spot (SP) is set so that a part thereof is irradiated not only to the groove track **12** but also to the land track **13**.

The pre-information is detected from the prepits **14** by using a part of reflection light of the light spot (SP) irradiated on the land track **13** by, for example, a push-pull method, so that the pre-information is obtained. The push-pull method (a radial push-pull method) is executed using a photodetector divided or partitioned by a line that is parallel to the tangential direction of the groove track **12** (i.e., the rotating direction of the optical disc **11**). Also, a wobble signal is extracted from the groove track **12**, so that a clock signal for recording which is synchronized with the rotation of the disc is obtained.

The recording information data to be recorded on the optical disc **11** has previously been divided every sync frame as an information unit. One recording sector is formed by 26 sync frames. One ECC block is formed by 16 recording sectors. One sync frame has a length which is 1488 times (1488T) as long as a channel bit length ("T") that is specified by a recording format at the time when the recording information data is recorded. Further, a head portion of a length of 32T of one sync frame is used as sync information SY for obtaining synchronization of every sync frame.

The groove track **12** is wobbled at a predetermined wobbling frequency f0 (for example, 140 kHz) for all of the sync frames. In the information recording/reproducing apparatus, a signal for rotation control of a spindle motor is detected and the clock signal for recording is generated by extracting the predetermined wobbling frequency f0.

The first embodiment of the present invention will now be described in detail with reference to FIGS. **4** and **5**.

FIG. **4** shows the details of a lead-in area of a DVD-RW disc. Data such as a reference code, control data, is included in the lead-in area. An RW-physical format information zone is provided and important control data for recording/reproduction control of the disc has been written as phase change pits in the zone. In a control data zone locating at the same address as that of the control data area of the DVD-ROM mentioned above, in order to inhibit recording and reproduction of the control data into/from the area, the groove track is formed in a segmented manner.

FIG. **5** is a plan view schematically showing a boundary area of the buffer zone **1** and the control data zone on the DVD-RW disc according to the first embodiment of the present invention. The control data zone is a segmented groove area **21A** (a first area) comprising segmented groove tracks **12A** in which a plurality of groove portions **22A** are formed in the rotating direction of the optical disc **11**. In other words, the segmented groove track **12A** comprises the groove portions **22A** and groove non-forming portions (hereinafter, referred to as mirror portions) **25** where no groove is formed. Another area (a second area) such as buffer zone, or data area, etc. is a non-segmented groove area (hereinafter, referred to as a continuous groove area) **21B** comprising groove tracks (hereinafter, referred to as continuous groove tracks) **12B** in which a groove has been continuously formed (i.e., the groove is not segmented).

In more detail, the segmented groove tracks **12A** are alternately arranged and formed at a predetermined track pitch. The continuous groove tracks **12B** are also arranged and formed at a predetermined track pitch. Each groove portion **22A** of the segmented groove track **12A** comprises: a fundamental pit portion **23** serving as either one of a mark portion or a space portion; and an extension portion **24** of a groove having a predetermined length. In other words, the extension portion **24** is a groove portion that is appended continuously to the fundamental pit portion **23**. The fundamental pit portion **23** carries a mark portion (or a space portion) while the extension portion **24** and the mirror portion **25** (groove non-forming portion) are included in a space portion (or mark portion).

The segmented groove track **12A** is formed by, for example, a method whereby a cutting light beam upon groove cutting is 8/16 modulated and an emitting power is controlled between on and off operation. More particularly, the groove track **12A** has an intermittent structure segmented according to a signal of the same frequency band as that of a recording RF signal (i.e., recording signal obtained after 8/16 modulation) which is recorded on the optical disc by the optical disc recording/reproducing apparatus.

Even if the 8/16 modulated control data is recorded on the segmented groove track having the above structure, an amplitude of the RF signal reproduced from the segmented groove track **12A** is small, so that the RF signal cannot be read out. This is because the frequency band of the RF signal

that is due to the intermittence (i.e., between ON and OFF) of the groove track is equivalent to or comes within that of the recorded RF signal, so that the signals interfere with each other.

In the embodiment, the fundamental pit portion **23** has a pit length corresponding to a mark (or space) of an 8/16 modulation signal S2 in a manufacturing apparatus, which will be explained hereinlater. For example, if the 8/16 modulation for converting data of 8 bits into data of 16 channel bits is used as a modulating method, the minimum pit length of the fundamental pit portion **23** is equal to 3T and the maximum pit length is equal to 11T (T: channel bit length). For example, the maximum pit length is equal to 14T when a pit having a length 14T is used as a sync pattern.

The extension portion **24** has a length of 3T×0.73 based on an extension signal S3, which will be explained hereinlater. A width W1 (in the embodiment, 0.31 μm) of each groove portion **22A** on the segmented groove track **12A** is larger than a groove width W2 (0.26 μm) of the continuous groove track **12B** but is smaller than a half of the track pitch (0.37 μm, the track pitch=0.74 μm).

Description will now be made hereinbelow with regard to how to determine each groove width and each groove length mentioned above. In the embodiment, the segmented groove track **12A** is formed so that the duty ratio of all the fundamental pit portions **23** included in the segmented groove track **12A** is approximately 50%.

FIG. **6** is a graph showing a photodetection signal level in the push-pull method (hereinafter, simply referred to as a push-pull signal level) to the length of extension portion **24**. In the embodiment, the groove portion **22A** is formed by adding the extension portion **24** to the fundamental pit portion **23** to improve the push-pull signal level for tracking control.

As shown in FIG. **6**, the push-pull signal level increases as the extension portion **24** becomes longer. Even if the groove track is formed in a segmented manner, the level of the reproduction RF signal increases by the repetitive recording of the same illegal control data, so that the prevention of the recorded data reading becomes imperfect. The illegal reading can be prevented by shortening the extension portion **24**, however, the pushpull signal level decreases as mentioned above and an adverse influence is produced on tracking performance. This trade-off can be solved by optimizing the groove width of the groove portion **22A** in addition to the length of the extension portion **24**.

As shown in FIG. **7**, the push-pull signal level changes in accordance with the groove width. The push-pull signal level reaches a maximum value at a value near a half (i.e., 0.37 μm) of the track pitch (0.74 μm). Therefore, the groove width should be determined to lie within a range from the groove width (0.26 μn) of the continuous groove track **12B** to a half (i.e., 0.37 μm) of the track pitch (0.74 μm). The length of extension portion **24** should be determined to have a value such that the signal level which does not affect the reproducing operation in consideration of an increased amount of the signal level which is compensated by the increase of the groove width mentioned above.

FIG. **8** shows the RF signal level due to the intermittence of the groove track as a function of the groove width. In this calculation, it is assumed that the fundamental pit portion carries data obtained by the 8/16 modulation and the extension portion **24** has a length of 3T×0.73.

The RF signal level that is caused due to the segmented groove track becomes a maximum value at a groove width which is slightly smaller than a half (i.e., 0.37 μm) of the track pitch (0.74 μm). To prevent the illegal reproduction, therefore, the groove width of the groove portion **22A** is determined so as to increase the RF signal level.

Therefore, an optical disc can be provided in which the reduction of the push-pull signal level can be avoided and the illegal recording and reproduction can be prevented by determining the groove width of the groove portion **22A**, the length of extension portion **24**, and the track pitch as mentioned above.

A duty ratio or the like of the fundamental pit portion **23** can be properly changed in consideration of the photodetection signal level.

Although the embodiment has been described with respect to the example in which the extension portion **24** is added to the groove portion **22A**, it is not always necessary to provide the extension portion **24**. In this instance, the groove width and the length of each groove portion can be determined in accordance with the duty ratio of the groove portion of the segmented groove track in a manner similar to that in the foregoing first embodiment.

Although the embodiment has been described with respect to the example in which the segmented groove track **12A** is divided by the signal of the same band as that of the recording RF signal for the optical disc, it can also be segmented by a signal including a part of the band of the recording RF signal. Further, the prepits can also be constructed on the land track.

A manufacturing apparatus of a DVD-RW disc according to the second embodiment of the present invention will now be described in detail with reference to the drawing. FIG. **9** is a block diagram showing a configuration of a manufacturing apparatus **30** of a master disc of an optical disc.

A photoresist **41B** is coated on a glass substrate **41A** serving as a master disc of the DVD-RW disc and patterned through a conventional photolithography and etching process.

When the laser beam is irradiated in the control data zone (a first area), a dummy control data signal S1 to form the segmented groove track **12A** is generated in a recording signal generating circuit **31**. The generated dummy data signal S1 is 8/16 modulated in an 8/16 modulator **32**. The extension signal S3 used to extend a mark portion of the 8/16 modulation signal S2 by 3T×0.73 is generated in an extension signal generating circuit **40**. The extension signal S3 is added to the modulation signal S2 in an adding circuit **42** and an addition signal S4 is supplied to a power control circuit **33**.

A groove width control signal S6 to set the width of groove portion to 0.31 μm is supplied from a controller **34** to the power control circuit **33**. The power control circuit **33** generates a laser power control signal S8 on the basis of the addition signal S4 and a power control signal S7. The power control signal S8 is supplied to an AO (acousto-optic) modulator **38** through an AO driving circuit **39**. The AO modulator **38** turns on/off the laser beam from g'i an argon laser **37** on the basis of the addition signal S4 and adjusts a light power of the laser beam on the basis of the groove width control signal S6.

When the laser beam is irradiated in an area (a second area) other than the control data zone, the control signal S6 for setting the width of grooves to 0.26 μm and the control signal S7 to make the laser beam to be continuously irradiated are supplied from the controller **34** to the power control circuit **33**. The AO modulator **38**, therefore, allows the laser beam emitted from the argon laser **37** to pass through irrespective of the addition signal S4 and adjusts the laser beam power on the basis of the groove width control signal S6.

A wobble signal generating circuit **35** generates a wobble signal S**9** of a sine wave shape to form a wobble to the groove track irrespective of the irradiation area of the laser beam and supplies the signal to a frequency modulator **36**. The supplied wobble signal is frequency modulated by the frequency modulator **36**, so that a predetermined frequency modulation signal S**1** (for example, signal whose center frequency is equal to 140 MHz and which changes in a range from 139 MHz to 141 MHz) is generated.

The frequency modulation signal S**10** is supplied to the AO modulator **38** through the AO driving circuit **39**. The AO modulator **38** controls an emitting direction of the laser beam from the argon laser **37** on the basis of the frequency modulation signal. As mentioned above, since a power of the laser beam which is supplied to the AO modulator **38** is controlled by the control signal S**8**, the photoresist **41**B is exposed by the laser beam from the AO modulator **38**, so that it is possible to form a resist pattern for forming the wobbled segmented groove track **12**A having the groove width 0.31 μm and the wobbled continuous groove track **12**B having the groove width 0.26 μm. A master disc for an optical disc having the segmented groove tracks and the continuous groove tracks can be formed by etching a master disc glass substrate **41** on which the resist pattern has been formed. The optical recording media mentioned above can be manufactured by using the master disc.

The numerical values or the like used in the embodiments are shown as examples and can be properly modified in accordance with the kind of optical recording medium, the light source wavelength of the optical pickup, the optical system, and the like.

As will be obviously understood from the above explanation, according to the present invention, it is possible to provide the optical recording medium and a manufacturing method and apparatus therefor, which can prevent the illegal recording and reproduction of data from the disc.

The invention has been described with reference to the preferred embodiments thereof. It should be understood by those skilled in the art that a variety of alterations and modifications may be made from the embodiments described above. It is therefore contemplated that the appended claims encompass all such alterations and modifications.

This application is based on a Japanese Patent Application No. 2000-205328 which is hereby incorporated by reference.

What is claimed is:

1. A rewritable optical recording medium having a substrate, land tracks and groove tracks for recording a data signal, the land tracks and the groove tracks being formed in the substrate, and each of the groove tracks being positioned between neighboring ones of the land tracks, respectively, comprising:

a segmented groove area in which the groove track is segmented along a rotating direction of said optical recording medium to form a plurality of groove portions; and

a continuous groove area in which a continuous groove track is formed, said continuous groove track having a groove width smaller than groove widths of the plurality of groove portions in said segmented groove area.

2. The medium according to claim **1**, wherein the groove width in said segmented groove area is smaller than a half of a groove track pitch.

3. The medium according to claim **1**, wherein the groove widths of the plurality of groove portions in said segmented groove area are based on a track pitch of the groove track and lengths of the plurality of groove portions in said segmented groove area.

4. The medium according to claim **1**, wherein the groove portions of the segmented groove area are spaced from each other at intervals, and the intervals are based on a part of a frequency band of a data signal which is recorded on said optical recording medium.

5. The medium according claim **1**, wherein said segmented groove area is a control data recording area for recording a reproduction control data signal.

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